STATE: **Montana**
AGENCY: **Fish, Wildlife & Parks**
GRANT: **Sage-Grouse Grazing Evaluation**
MT TRACKING: **W-158-R**

Annual Report

Sage-Grouse Grazing Evaluation Study

July 1, 2013 – June 30, 2014

Submitted by:
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BACKGROUND

The greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) is a gallinaceous bird species endemic to semi-arid sagebrush (*Artemisia* spp.) habitats in western North America (Schroeder et al. 1999). The loss and degradation of the sagebrush habitats upon which this species depends has led to its extirpation from over half of its original range (Schroeder et al. 2004). Threats to sage-grouse populations and the sagebrush landscapes on which they depend vary across their range, including increasing oil and gas development (Naugle et al. 2011), conifer invasion into sage steppe habitats (Baruch-Mordo et al. 2013), conversion of grasslands to tillage agriculture ("sod-busting"; Walker 2008), disease (i.e., West Nile virus; Walker and Naugle 2011), urban encroachment in sagebrush landscapes (Brunson and Huntsinger 2008), and livestock grazing (Connelly et al. 2004). These dramatic declines in sage-grouse populations have led to the recent designation of this species as 'warranted' for protection under the federal Endangered Species Act (ESA), but action is precluded by more pressing issues (ESA; United States Department of the Interior 2010). A decision on whether to list sage-grouse will be finalized in 2015.

Private lands contain 30% of the 48 million ha of sagebrush habitat (including key sage-grouse breeding areas) with Montana among the states with the most sagebrush in private ownership (Connelly et al. 2004). For landscape species such as sage-grouse, private lands conservation and maintaining "working landscapes" has become a major means by which conservation and management occurs (Raven 1990; Brunson and Huntsinger 2008). Sod-busting and ranchland conversion to commercial or residential developments are occurring at high rates in the West, and efforts to sustain working ranches is a forward looking approach to landscape conservation (Brunson and Huntsinger 2008).

Research suggests that, done appropriately, livestock grazing can be used as a tool to improve sagebrush habitat for sage-grouse (Connelly et al. 2004). Still, no study has quantified sage-grouse response to rotational grazing systems to assess their effectiveness in maintaining populations. Our goal is to evaluate the effectiveness of grazing systems designed by the Natural Resources Conservation Service (NRCS) for sage-grouse and provide information that will allow the agency to improve their grazing programs if needed. The NRCS Sage-Grouse Initiative (SGI) and its partners are implementing rest-rotation grazing systems as a tool to help bolster sage-grouse populations through sustainable ranching and obviate the need to list the species. The NRCS has enrolled private lands into SGI, which provides technical and financial cost share for ranchers to allow 20% of their land area to rest each year for five years through a combination of rest and deferment. In addition, we are evaluating grazing treatments (see below **Work Completed**) within the SGI systems to be able to generalize results of this study to grazing systems other than SGI (e.g., systems managed by Montana Fish, Wildlife and Parks [FWP]). This will allow multiple agencies to better manage for sage-grouse in relation to livestock grazing. Several partners including NRCS, The University of Montana, FWP, and the U.S. Bureau of Land Management (BLM) oversee this project and are regularly consulted regarding its design and results to ensure that our products are meeting their needs.

OBJECTIVES

The short-term objective of this 1-year funding period was to study the direct effects of livestock grazing systems on the population dynamics of sage-grouse and their associated habitat in Musselshell and Golden Valley counties, Montana (Fig. 1) during the 2013-2014 field seasons. We continued the collection of data to help evaluate the effectiveness of SGI grazing systems as a habitat management tool for stabilizing or improving sage-grouse habitat and populations.

Adult female (hen) survival, nest success, and chick survival are the three most important factors influencing the population growth of sage-grouse—more influential than, for example, nest initiation dates or clutch sizes (Taylor et al. 2012). Past research showed that vegetation variables such as taller grass height translated into higher nest success for sage-grouse hens (Doherty et al. 2010). Thus we continued data collection to evaluate the direct effects of grazing treatments on these three vital rates and on sage-grouse habitat via the following long-term objectives:

1. Measure and compare the vegetation response in pastures among different grazing treatments, relative to published sage-grouse habitat needs;
2. Identify seasonal movements and habitat selection by sage-grouse hens and chicks to quantify use of different grazing treatments proportional to habitat availability and other drivers of sage-grouse resource selection; and
3. Measure individual vital rates known to impact population growth in sage-grouse and relate these estimated vital rates directly to habitat variables and other important drivers.

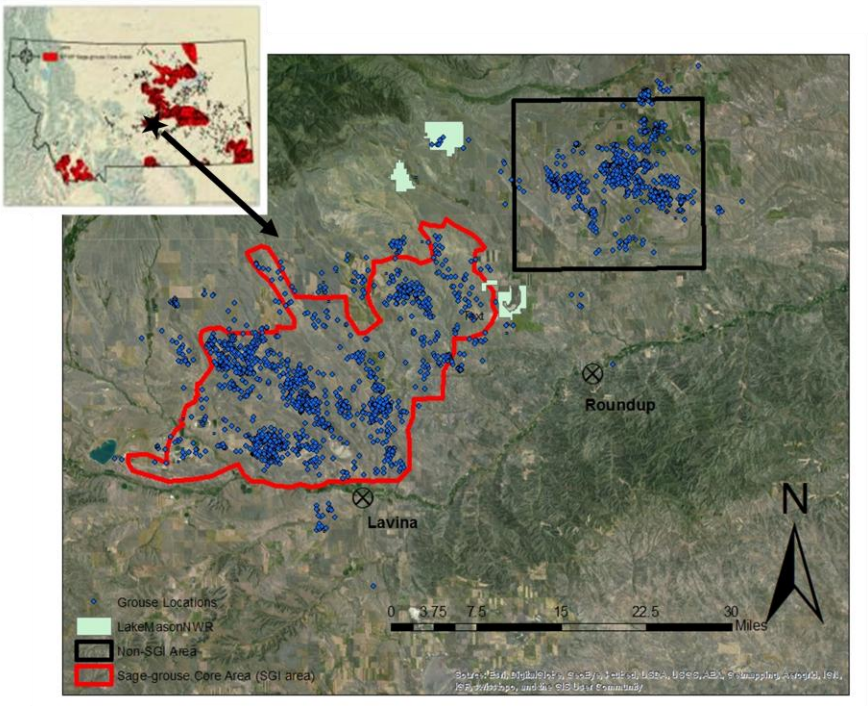

Figure 1. A map of the project area north of Lavina and Roundup, Montana, in Golden Valley (western portion) and Musselshell (eastern portion) Counties. The project area includes a sage-grouse core area (red boundary) delineated by FWP where SGI grazing systems have been implemented and an area 25 mi north of Roundup, Montana (black border) where no SGI systems have been implemented. The light green polygons represent the locations of the 3 Lake Mason satellite units of the Charles M. Russell National Wildlife Refuge in Musselshell County, Montana: the Willow Creek, North, and Lake Mason units (in order from left to right).
The blue dots are locations of all greater sage-grouse hens and chicks to date that we have monitored using radiotelemetry.

A critical need for the NRCS is a full understanding as to the near and long-term benefits and appropriate refinements of prescribed grazing systems that are intended to benefit sage-grouse. We share our results with NRCS as they become available. This enables NRCS to strategically locate future SGI contracts or make modifications to current grazing systems, similar to an adaptive management framework.

It is increasingly important to make evaluations at an ecosystem level; grazing systems will not only impact sage-grouse, but also vegetation, many other wildlife species, and the food upon which they depend (insects and plants). Thus, it is important to evaluate the effects of grazing systems on these multiple components because these components are interconnected. We are incorporating these components—effects on other wildlife as well as food for sage-grouse—by collaborating with The University of Montana and Montana State University to evaluate the effects of grazing systems on songbirds and insects, respectively. These evaluations are funded and conducted independently of our sage-grouse evaluation, but dovetail with our sage-grouse work to look at impacts of SGI grazing systems on other sagebrush and grassland birds as well as food availability for sage-grouse. This collaborative approach is essential to understand all facets of the impacts of grazing systems on rangelands and wildlife, and it further leverages funding contributions for this project to specifically understand the impacts of grazing management on sage-grouse and sage-grouse habitat. This approach is also a unique and critical opportunity to determine the long-term impacts of changes in land-use practices on the larger ecosystem scale—the scale at which these changes are occurring and need to be addressed.

WORK COMPLETED

We monitored sage-grouse hens on SGI contracted lands (hereafter SGI area) and compared these data with data from hens that we monitored on areas where there were no SGI grazing systems (hereafter non-SGI areas). We have completed 3.5 years of data collection for this 10 year study. Work completed includes capturing and radio-marking hens, finding and monitoring nests, capturing and radio-marking chicks, and measuring key vegetation characteristics in sage-grouse habitat and in areas with varying grazing treatments. We used radiotelemetry to collect data on hen survival, nest success, and chick survival. We collected vegetation data at nests and unused sites in potential sage-grouse nesting habitat to measure the influence of vegetation and grazing treatments on sage-grouse vital rates and habitat use. We also collected data at rested and un-rested pastures on ranches included in SGI as well as non-SGI ranches to get a separate measure regarding how vegetation responds, in general, to

SGI grazing systems. In addition to the SGI / non-SGI comparison, each pasture that sage-grouse used was placed into 1 of 4 grazing treatments. These treatments were defined with respect to sage-grouse ecology rather than SGI grazing systems to enable us to extrapolate the results to other grazing systems. The treatments will also provide additional insights into SGI grazing systems and if/how the systems can be improved:

1. Grazed during the nesting season (April 1st – July 20th),
2. Grazed during brood-rearing (July 21st – September 15th),
3. Grazed during fall/winter after broods break-up until the start of the next breeding/nesting season (September 15th – Apr 1st), or
4. Rested the entire year (Apr 1st – Apr 1st the following year).

During the funding period we broadened the scope and scalability of this project by (1) partnering on a sage-grouse study with Montana State University in Beaverhead County, Montana that will allow us to test the robustness of our results with data from a different location, and (2) partnering with U.S. Fish and Wildlife Service (USFWS) to expand our vegetation sampling to new locations. The sage-grouse study in Beaverhead County tests sage-grouse population responses to grazing management by adding or removing cattle in pastures containing sage-grouse broods. This study is independently funded and operated relative to our study. We will be able to test the robustness of our population and habitat models with data from this new location and determine the scope of our inferences beyond central Montana. In addition, we have received funding from USFWS to expand our habitat monitoring in 2014 to new areas where SGI systems will be implemented but where grazing has been absent for 3-12 years. We will extend our sampling of the vegetation in response to grazing to 3 satellite units of the Charles M. Russell (CMR) National Wildlife Refuge that are adjacent to our project area: the Lake Mason, Willow Creek, and North Units (Musselshell County, Montana). Sampling these sites presents a unique opportunity to monitor these rangelands before and after grazing which will improve our inferences about grazing as a habitat management tool. The additional funding allows us to expand our landscape geographical information system (GIS) map to locations on our study area in use by sage-grouse but not yet mapped. The landscape GIS provides data on sagebrush, grass, and bare ground cover at a 1x1m or 30x30m resolution over the entire 202,300+ ha where we monitor sage-grouse, vegetation, and grazing.

PRELIMINARY RESULTS

We highlight that this is a long-term study intended to last ≥ 10 years, and that these results are preliminary and subject to change because data entry and proofreading have not been completed. The preliminary results from the first 3.5 years of our study indicate that SGI systems are having a positive impact. However, annual weather fluctuations and lag responses in habitat and sage-grouse population vital rates to habitat management preclude strong inferences from these first years. We will continue this project over the long-term to be able to more rigorously examine our preliminary results. Below we have summarized the results from the first three years of the study (Berkeley et al. 2013).

Part of the goal of SGI is to produce more hiding cover for nesting hens. Our preliminary results (Berkeley et al. 2013) indicate a trend that pastures enrolled in SGI produced taller grass. Fig. 2 summarizes residual grass heights in non-SGI (these pastures were grazed by private

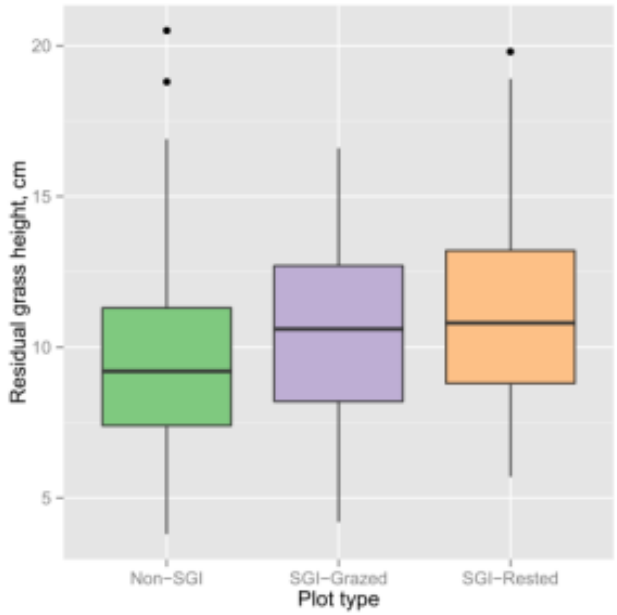

Figure 2. Residual grass height at vegetation response plots on non-SGI pastures (n = 117), SGI pastures grazed in the past year (n = 47), and SGI pastures that had been rested from grazing since the previous nesting season (n = 114). All plots were measured in July 2013. Figure by project partner and Ph.D. Candidate Joseph Smith, University of Montana.

landowners, but not using SGI systems), grazed SGI, and rested SGI pastures. The residual grass height appeared greatest in both rested / deferred (≥15 months) and grazed SGI pastures than in non-SGI pastures. Nesting sage-grouse hens seemed to select these areas with more residual grass (Fig. 3), and preliminary analyses showed that their nests were more successful in areas

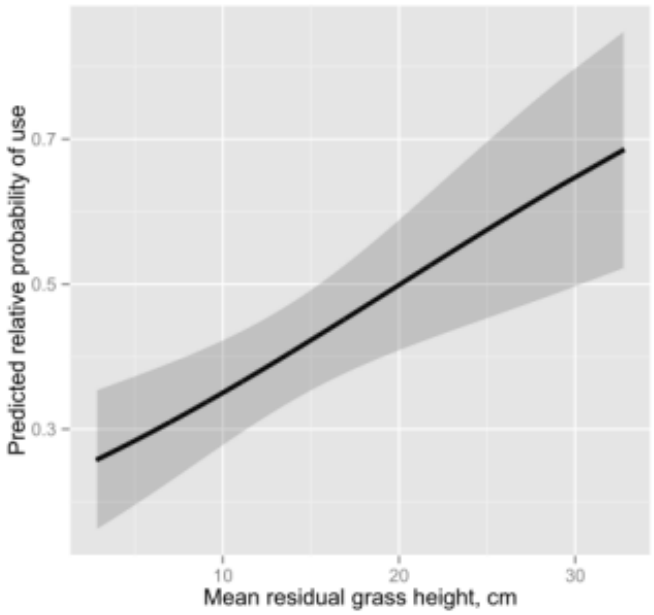

Figure 3. Predicted relative probability of use as a function of residual grass height (excluding inflorescence) within 6 m of the nest shrub from top RSF model. Predictions are made with all other covariate values held at their mean value. Shaded gray area is the 95% confidence region calculated using the delta method as implemented using the predictSE.mer() function in the AICcmodavg package in program R. Figure by project partner and Ph.D. Candidate Joseph Smith, University of Montana.

with more residual grass (Fig. 4). We predict that we will begin to see a difference in nest success rates in favor of SGI pastures in the next few years if landowners continue the SGI grazing systems. With further analyses we will attain a more in-depth look at the effects of environmental and vegetation variables on all vital rates and habitat selection.

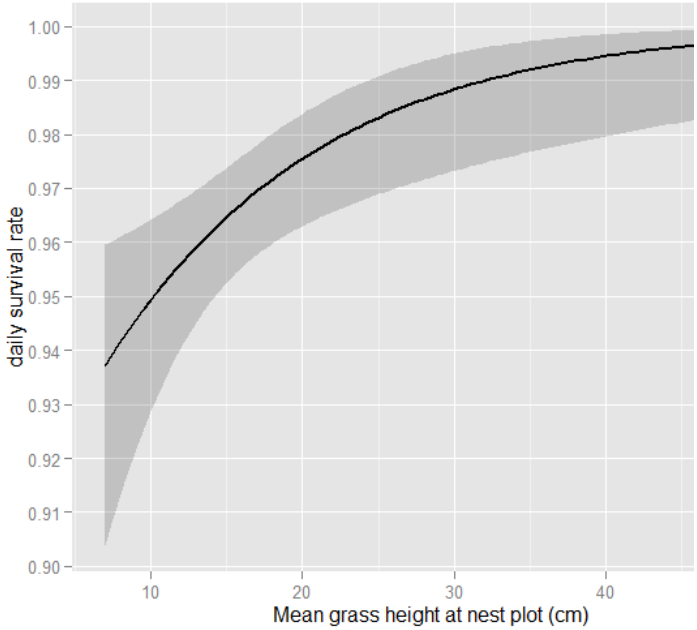

*Figure 4. Daily survival rate of greater sage-grouse nests as a function of average grass height within 6 m of the nest shrub in Golden Valley and Musselshell counties, MT from the top-ranked model of daily survival rate (Year + Year*SeasonDay + Pgrass_ht); predicted DSRs are based on a nest midway through the 2013 nesting season.*

Preliminary results from the insect study (Hayes Goosey, Montana State University) show that the insects relied upon by sage-grouse hens and chicks for food during the summer were more

abundant where grass was taller (Fig. 5). These results suggest "that rested/deferred pastures harbor an increased abundance of food arthropods (Fig. 6; Goosey 2014).

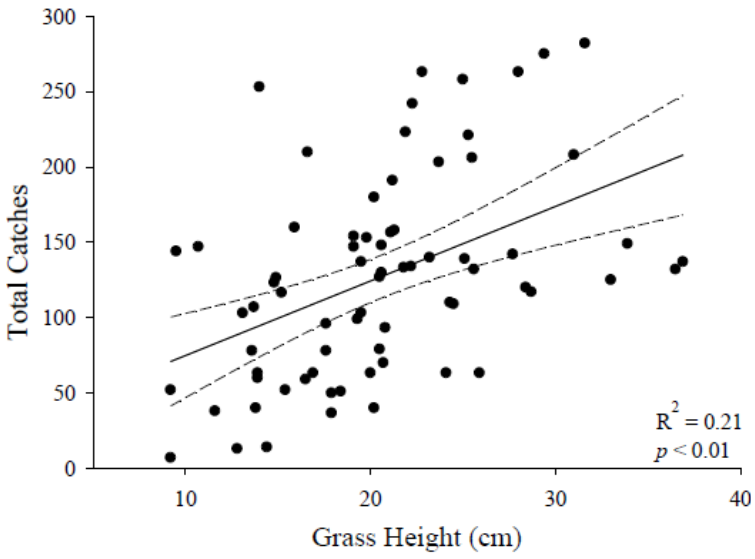

Figure 5. Linear relationships (solid line), with 95% confidence intervals (dashed lines), between the total pitfall trap catches of food arthropods for sage-grouse (collected across all dates) and live grass height (from Goosey 2014).

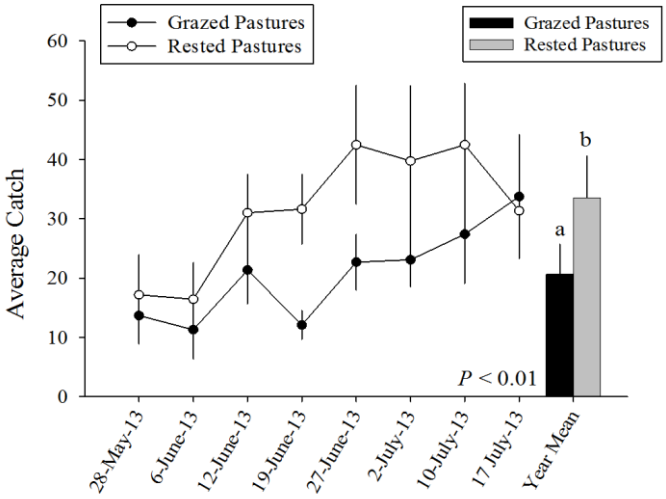

Figure 6. Averaged catches across all arthropod taxa (beetles, butterfly and moth larvae, grasshoppers and crickets, ants, and spiders) in pastures which were either rested/deferred or grazed during the early brooding period of late May to early July. Lines represent the average weekly catches, bars represent the averaged catch for the sampling year, and error bars represent the standard error of the mean (from Goosey 2014).

NEW PROGRESS: DECEMBER 2013 – JUNE 2014

Hen Survival

We measured both annual and seasonal survival of sage-grouse hens. We defined our seasons following Blomberg et al. (2013): spring = Apr – May, summer = June – July, fall = Aug – Oct, winter = Nov – Mar. Apparent winter survival of hens (number of hens still alive / the number of total hens monitored) from Nov 2013 – Mar 2014 over the entire study area (both SGI and

non-SGI areas combined) during the third year of this project was 92%, which was the highest winter survival we have measured out of all 3 winters during the study (Fig. 7). Apparent annual survival of hens during 2013 (Apr 2013 – Mar 2014) was 76%, which was the highest of all complete years of the study (2014 is not complete yet; Fig. 7).

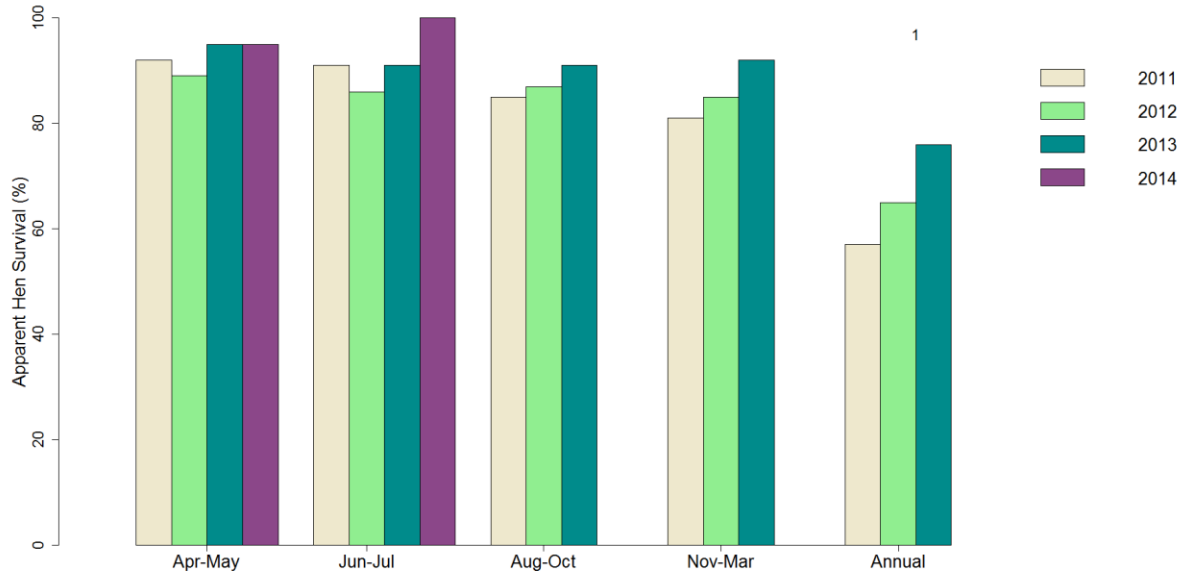

Figure 7. Apparent seasonal and annual survival (number of hens still alive / total number of hens monitored) of our marked population of greater sage-grouse hens in Golden Valley and Mussellshell Counties, Montana during 2011-2014 for both SGI and non-SGI areas combined.

In March and April 2014 before the nesting season, we captured and marked 44 sage-grouse hens with radio transmitters to bring our total sample size to 102 marked hens at the start of the 2014 season. These hens were captured throughout both SGI and non-SGI areas.

Nest Success

Data entry for 2014 is not yet complete, but preliminary numbers show a total of 74 nests for the entire nesting season. Apparent nest success (number of successful nests / total number of nests) this season was 62%, which is higher than all previous years. We defined a "successful nest" as a nest that hatched at least one chick. For nests located in pastures that were enrolled in SGI, apparent nest success was 65%, and for nests in pastures that were not enrolled in SGI, apparent nest success was 60% (Table 1). We have not yet completed any formal nest success analyses for this season, but we speculate that the high nest success observed this season may be related to favorable weather conditions this year. Weather variables such as precipitation have a large influence on vegetation (Gillen and Sims 2006) and therefore food availability (both flowering plants and insects) and protective cover.

Treatment	Year			
	2011	2012	2013	2014**
SGI	36%	49%	42%	65%
Non-SGI	12%	61%	36%	60%

***2014 total apparent nest success numbers may change because data entry has is not yet complete.*

Table 1. Apparent nest success (number of successful nests / total number of nests) for greater sage-grouse nests in Golden Valley and Mussellshell Counties, Montana from 2011-2014.

To put these numbers in perspective, nest success varies from 14 – 86% across the entire range of sage-grouse (including studies from Oregon, Colorado, Idaho; Connelly et al. 2004). The average nest success across the range is 46% (Connelly et al. 2011).

Chick Survival

In May through July 2014 we marked 73 sage-grouse chicks with radio transmitters to monitor their survival and habitat use. This is a preliminary look at data from the 2014 season because the season is not yet complete. We are currently still monitoring 22 marked chicks, which gives us an apparent chick survival of 30%. This raw estimate is calculated as the number of chicks still alive / the number of total chicks monitored. Previous years' apparent survival estimates for the entire study area (SGI and non-SGI areas combined) were 21%, 10%, and 17% for 2011-2013, respectively. Thus in 2014, this sage-grouse population experienced the highest chick survival rates since the start of the project in 2011. These are preliminary results that have not been through formal analyses yet. Previous studies have shown chick survival to be variable and range from 12-50% during the first few weeks after hatching (Aldridge and Boyce 2007, Gregg et al. 2007, Dahlgren et al. 2010, Guttery et al. 2013). Weather conditions during the sensitive post-hatch time, which peaks in early June for many prairie grouse, may have a large impact on chick survival (Flanders-Wanner et al. 2004). For example, many chicks get chilled and die during heavy rain events during the post-hatch period (Horak and Applegate 1998). We speculate that higher chick survival this year may be related to favorable weather conditions during the 2014 spring and early summer.

DELIVERABLES

Our activities related to this study include written products, presentations, and sharing our research with livestock producers, landowners, NRCS and federal land management staff, and wildlife management agencies. Below is a list of our activities during the funding period (July 1 2013 – June 30, 2014).

Professional Meetings

Activity	Description	Delivery Dates
Western Agencies Grouse Workshop	29th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop in Elko, Nevada. Learned about current research and issues across the range of the greater sage-grouse and networked with several greater sage-grouse researchers.	June 2014
Montana Chapter of The Wildlife Society Annual Meeting	We gave an oral presentation on our research at the 52nd Annual Conference of the Montana Chapter of the Wildlife Society in Bozeman, Montana: Smith, J. T., L. I. Berkeley, H. Goosey, M. Szczypinski, G. D. Johnson, K. M. O'Neill, M. G. Rolston, J. Gude, and D. E. Naugle. A demonstration of using partnerships and private lands conservation to evaluate livestock grazing as a management tool for greater sage-grouse in central Montana. Oral presentation at the 52nd Annual Conference of the Montana Chapter of the Wildlife Society in Bozeman, Montana.	March 2014
Annual Oversight Committee Meeting & Field tour	We present our progress and discuss issues such as research design with our oversight committee on an annual basis. In 2013 we hosted the committee meeting in Roundup and included a field tour where we demonstrated data collection techniques.	Sep 2013
Oral Presentation - Governor's Sage-grouse Citizen's Advisory Council	Presented an overview and preliminary findings from our study to the Governor's Sage-Grouse Citizen's Advisory Council.	July 2013

Landowner Appreciation

Activity	Description	Delivery Dates
Landowner Appreciation Dinners, Roundup and Lavina, MT	We host a dinner that includes local NRCS employees, landowners whose land we access to monitor birds, collaborators, and our field crew to thank the landowners and give them updates on our project at the end of each field season. We participated in a NRCS-hosted dinner in 2013 and hosted our own dinner in 2014.	Sep 2013, July 2014

Partnerships

Activity	Description
Idaho Fish & Game	Coordinating with Jack Connelly on his spring grazing sage-grouse study in Idaho that began in spring 2014. Hosted Jack on our study area and gave a field tour.
U.S. Fish and Wildlife Service	We have partnered with and received additional funds from the U.S. Fish and Wildlife Service to expand our habitat monitoring. In spring 2014, we made plans to begin vegetation sampling on the 3 Lake Mason satellite units (Lake Mason, Willow Creek, and North units) of the Charles M. Russell National Wildlife Refuge. These are areas where grazing has been absent for 3-12 years and SGI systems will be implemented. We will monitor these rangelands starting in July 2014 before and after grazing which will improve our inferences about grazing as a habitat management tool.
Montana State University	We have partnered on a study in Beaverhead County, Montana, which is located in sage-grouse management zone 4 and Montana Fish, Wildlife, and Parks sage grouse core area 10: "Landscape Collaborative Grazing and Greater Sage-grouse Survival" study. Principal Investigators: Bok Sowell, Professor and Michael Frisina, Adjunct Professor, Department of Animal and Range Sciences, Montana State University. We will use data from this project to make comparisons with our study.
Montana State University	Ongoing partnership (since 2012) with Research Scientist Dr. Hayes Goosey, Department of Animal and Range Sciences, Montana State University, on a concurrent study that leverages our relationships with landowners and established grazing treatments and provides key data on food availability for greater sage-grouse hens and chicks in our study: "Modeling the Response of Food Insects of Sage-Grouse to Rest-Rotation Grazing".
University of Montana	Ongoing partnership (since 2012) with Dr. Victoria Dreitz, Assistant Professor, Wildlife Biology Program and Director, Avian Science Center, The University of Montana on a concurrent study that leverages our relationships with landowners and established grazing treatments: "Assessing Land Use Practices on the Ecological Characteristics of Sagebrush Ecosystems: Multiple Migratory Bird Responses".

Progress Reports

Activity	Description	Delivery Dates
Pheasants Forever and Intermountain West Joint Venture (3)	We submit biannual progress reports to the Intermountain West Joint Venture and Pheasants Forever.	August 2013, December 2013, April 2014
Landowners and Oversight Committee (multiple)	We produce at least 2 progress reports per year for landowners and our interagency (NRCS, MFWP, BLM, UM, and MT DNRC) oversight committee.	September 2013, May 2014
Natural Resources Conservation Service (NRCS)	We submitted biannual funding progress reports to the NRCS Conservation Innovation Grants program (funding completed in September 2013).	May and December 2013

Outreach

Description	Delivery Dates
Invited to participate in a field tour of the Roundup Sage Grouse Core and Habitat with Dylan Laslovich, Senator Jon Tester's Congressional Representative. This was hosted by BLM.	Aug 14, 2014
Hosted Tim Baker, Governor Bullock's Policy Advisor for Natural Resources, in a field excursion to mark sage-grouse chicks with radiotransmitters.	June 2014
Hosted Senator John Walsh's natural resources aide and took him to view a sage-grouse lek.	May 2014

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